

OSTEOMYELITIS AND PYOGENIC
INFECTIONS OF JOINTS*

MATHER CLEVELAND

Orthopedic Surgeon, St. Luke's Hospital

THE English translation of Ambrose Paré's surgery, Book 19, Chapter 26, published in London in 1634, is titled, "Why Bones Become Rotten and By What Signs It May Be Perceived." Nearly 250 years elapsed before Pasteur's experiments established bacteriology and afforded the possibility of studying the infections in such a way that tuberculosis, syphilis and pyogenic infections could with certainty be recognized and classified as such. Taking Paré's text, "why bones become rotten," it is the purpose of this study of pyogenic suppurative disease of bones and joints to present a few phases of the problem as they exist today.

I am informed that an actuary considers that any attempt to draw conclusions on less than 10,000 samples is worthless. This should, if it be strictly true, make it extremely difficult for any single physician or group of physicians to speak dogmatically about any given medical subject. While most medical literature deals with a relatively small number of patients, perhaps by adding the experience of many physicians and pegging a few facts where there is agreement of opinion, a measure of truth may be gleaned.

In preparing this resume I have drawn from our clinical material on the orthopedic service at St. Luke's Hospital and I have consulted a number of surgeons who have recently written on the subject. I wish to acknowledge Wilensky's monograph,¹ the writings of Beekman and Sullivan,² Kennedy,³ Phemister⁴ and Starr.⁵ I have, fortunately, been able to secure unpublished communications from J. Albert Key,⁶ John Wilson⁷ and Edwin Ryerson⁸ which formed part of a symposium on osteomyelitis presented at the meeting of the American Orthopaedic Association of 1939.

Osteomyelitis or arthritis resulting by direct extension from the overlying skin as seen in compound fractures and gunshot wounds may

* Read October 16, 1940 in the Graduate Fortnight of The New York Academy of Medicine.

produce serious disability. The problem of properly immobilizing fractures that have to be transported in order to prevent simple fractures from being compounded cannot be overemphasized. If the compound fracture is present, a prompt debridement of the wound and definite, effective immobilization of the fracture until union takes place should prevent or materially lessen the incidence of this type of bone and joint infection. Should infection occur, adequate drainage must be provided, maintaining immobilization. Our experience at St. Luke's Hospital on the orthopedic service with these infected compound fractures and gunshot wounds has been of a salvage nature. In no instance has the original treatment been under our supervision and it therefore seems advisable to omit their consideration.

In osteomyelitis due to extension from an adjacent soft tissue abscess it may be conceded that earlier and more adequate drainage would greatly diminish the chance of extension to nearby bone. Of this type of osteomyelitis we have had none to treat as our colleagues in surgery and otolaryngology treat the infected fingers and middle ears respectively.

Hematogenous acute osteomyelitis or arthritis is a blood stream infection with a portal of entry or primary focus which in many instances cannot be recognized. Cuts, abrasions, infected blisters and furuncles afford such a portal from the skin to the blood stream, while diseased tonsils or pharynx or even typhoid ulcers of the intestinal mucosa represent various portals from the mucous membranes. This disease occurs predominately in the first two decades of life, and boys are more frequently subject than are girls.

Considering this disease as an acute blood stream infection or bacteremia, the localization in any given bone or joint is only an unfortunate event in its course. The fact that such localization often presents the first tangible evidence of the disease and that it affords a point of surgical attack has led to a cart-before-the-horse method of reasoning in the treatment of this at times terrifying clinical picture.

The minute anatomy of the long bones, which has been carefully studied, affords ample reason for the localization of bacterial emboli at certain recognized sites. The nutrient artery breaks up into terminal arterioles in the metaphysis adjacent to the epiphyseal line and here the infected emboli lodge. There is said to be no phagocytic action in the bone marrow. A vascular thrombosis occurs with death of tissue depend-

ing upon the extent of the thrombosis. This death of bone tissue varies from microscopic to massive bone slough or sequestration. Since bone is a rigid tissue, the formation of slough and repair by new bone or involucrum takes many months in contrast to abscess in soft tissue. The suppuration which attends this infected thrombosis spreads through the cortex of the bone, beneath the periosteum to the soft tissues. In the case of the upper femoral metaphysis, which is wholly within the capsule of the hip joint, such a spread of suppuration invariably results in a suppurative arthritis. Similar suppurative infections of bones adjacent to joints may, if undrained, invade the knee, ankle, shoulder or wrist joints, etc. A suppurative arthritis per se with no preexisting bone involvement occurs at times, due most frequently to gonococcus and less frequently to streptococcus and pneumococcus.

Since the bones most frequently involved in this disease are the long bones of the lower extremity, the pelvis and the vertebrae, i.e., those involved in weight-bearing, the question arises whether trauma may not play some role in the localization.

When one considers the fact that the vast majority of known primary foci in this disease arise on the skin, it is not surprising that staphylococcus of various types is the predominating bacterial agent responsible for this infection. On this point, there is universal agreement. It has been stated that as high as 90 per cent of these infections occurring between the ages of two and twenty years are due to staphylococcus. Streptococcus is second in frequency, and in patients under two years of age the frequency of streptococcus infection is high. After streptococcus there follow pneumococcus and *Bacillus typhosus* in that order as causative organisms.

The clinical picture that these patients with hematogenous acute osteomyelitis present is primarily one of sepsis. The primary focus may be lost sight of, or forgotten. The patient is seen with chills, fever, at times between 105 and 106 degrees, leukocytosis up to 80,000 and often profound toxemia. If there is localization there will be severe pain at or near the epiphyseal line of a long bone, limited motion and spasm in the adjacent joint, some swelling due to edema and exquisite tenderness. If such a patient is seen within five to eight days of the onset of illness, the roentgenogram will show little or nothing that is of diagnostic help. In certain fulminating cases death may supervene before any localization in bone takes place.

In differential diagnosis, several diseases must be ruled out. Gonococcus arthritis in a fulminating form may be confusing, but there is usually a history of multiple joint pains before the one joint becomes swollen, red, hot and painful. Aspiration of the joint and culture of the purulent fluid will establish the diagnosis. In scurvy the roentgenogram should show subperiosteal hemorrhage.

Acute rheumatic fever presents a hurdle over which, I must confess, I have tripped on one occasion. This embarrassing situation has been summed up by one surgeon who states that, "When acute rheumatic fever presents an abscess, it's osteomyelitis."

If the patient survives the initial onslaught of the disease and shows localization in a bone or joint, the question of treatment arises, and here there is difference of opinion. Divergence of thought among physicians who are intelligently and carefully studying the same subject with a full understanding that each is talking about the same condition may be extremely helpful. However, it is futile to present a jumble of infected compound fractures, hematogenous acute osteomyelitis and protracted cases of bone infection. Conclusions drawn from such diverse conditions can be of little value.

There is honest and reasonable difference of opinion regarding the proper procedure in the treatment of hematogenous acute osteomyelitis. However, the divergence is not as wide as might be expected. The disease in its onset is admittedly a general blood stream infection, and the treatment must be supportive. Dehydration, toxemia and exhaustion must all be combatted in many instances. Blood cultures should be taken at once and repeated at definite intervals. Many observers lay great stress on the bacterial concentration in the blood as a prognostic aid. A negative blood culture may only signify that at that particular moment there were no bacteria in the blood stream or it may mean that the blood stream infection has burned itself out and has been overcome. When there are consistently but few colonies of bacteria per cc. of blood, the prognosis is good; while a persisting large number of bacterial colonies per cc. means a grave prognosis. Staphylococcus bacteremia is more serious than that due to streptococcus. The incidence of positive blood culture varies considerably as may be seen in a series of three reports comprising 184 cases. In each instance a blood culture was taken. One series reported an incidence of 34 per cent positive blood cultures and another 67 per cent positive cultures. The average

for the entire 184 cases was 56.5 per cent positive. The incidence of positive blood culture is doubtless influenced by the time after onset of the disease that the culture is taken.

During this period of investigation and supportive treatment, the importance of repeated blood transfusions cannot be overemphasized. Up to this point most competent observers are in agreement. When there is definite localization in bone or joint, opinion varies as to the next step. There are those who claim that any surgery is futile and meddlesome, and even jeopardizes the patient's chance of recovery. Some of these surgeons insist on letting nature evacuate an abscess and others will incise and drain when there is frank pus. On the other hand, a larger group of surgeons believe that after properly fortifying the patient, any recognizable localized suppuration of bone or joint should be drained with minimal trauma and little or no insult to bone or soft tissue. The day of early radical surgery on these patients has gone, leaving a great many needless cripples to haunt our clinics and hospitals as reminders of an era of doubtful judgment when scalpel, mallet and chisel ruled the scene. All surgeons now agree that absolute rest and protection of the infected bone or joint must be secured by plaster-of-Paris bandage or brace.

To date the specific treatment of these infections has been largely unsuccessful. Those few which are due to hemolytic streptococcus have been influenced by sulfanilamide and allied drugs, but the vast majority which are due to staphylococcus have not been helped. I can find no agreement that bacteriophage is helpful in those cases nor that vaccines or sera have any influence.

The mortality in these cases occurs chiefly in the first week or ten days after onset in those patients in the first two decades of life. Since the proven presence of bacteria in the blood stream indicates that the general infection predominates, a higher mortality should be expected among those patients who show this evidence of sepsis. When death occurs, it is due to sepsis and to metastatic spread to soft tissues, pericardium, endocardium, meninges. The reported mortality varies almost unbelievably from 1.5 per cent to 26 per cent. This is probably due in part to the fact that authors are not reporting strictly the same condition. Some will adhere rigidly to hematogenous acute osteomyelitis, while others may include haphazardly cases of infected compound fractures, extension osteomyelitis and bone infections that have been seen

years after onset of the disease. In two recently reported series of cases, strictly limited to hematogenous acute osteomyelitis, the mortality was 9 per cent in 33 cases and 17.5 per cent in 218 cases respectively. It is agreed that it is a serious disease with a relatively high mortality.

When these patients are seen early and carefully and skillfully treated, early healing of the local bone condition may ensue in as high as 50 per cent of the cases. Twenty-five to 35 per cent or more will show sequestration, delayed healing and additional foci in bones and joints. Fifteen to 25 per cent of these cases may be fatal.

Those patients who heal early and remain healed and those unfortunates who succumb, no longer remain a surgical problem, but that intermediate group which presents the phenomena of delayed healing, additional foci, growth disturbances, deformities of bones and joints, contribute to that vast army of chronic suppurative bone and joint infection which haunts our hospitals and outpatient departments. One cannot escape the feeling that much of this is due to ill-advised original surgical treatment, where superimposed on vascular and infectious trauma is the insult of improperly placed incisions, too wide removal of uninvolved bone and failure to immobilize the damaged part.

Here the problem of wound healing is paramount, and various methods of sterilization of the sinuses have been advocated. Almost every known chemical has been tried. Maggots have been depicted as chewing up dead bone while it seems quite likely that their urinary secretions are the only factor of value. Such demonstrations of this method of treatment as I have seen have made me feel the urge to reach for a flit gun.

At the present time in most capable hands the most universally approved treatment of this chronic suppurative infection of bone is debridement, removal of obvious sequestra, a pack of vaseline gauze and application of a plaster-of-Paris bandage for immobilization.

The orthopedic service of St. Luke's Hospital has treated during the past 10 years 56 cases of hematogenous acute osteomyelitis, a mere drop in the statistical bucket. From these patients we have learned a great deal and a debt of gratitude is herewith acknowledged. Thirty-four of these 56 patients came to us during the acute stage of their disease, while the remaining 22 consulted us for recurrence of their original disease, for metastatic foci or for the correction of deformities incident to their original lesions.

Age At Onset. The disease is definitely and predominately one of

the first two decades of life. Eighty-seven per cent of our patients were under 20 years of age at the time of onset of their disease. The age incidence is as follows:

1 year and under.....	6	} 87.5 per cent	21-30 years.....	2
1-2 years.....	1		31-40 ".....	1
2-10 ".....	24		41-50 ".....	3
11-20 ".....	18		51-60 ".....	1
Total			56	

There were 33 males and 23 females among these patients.

THE BONES OR JOINTS INVADDED WERE AS FOLLOWS

Weight-bearing Bones or Joints		Non-weight-bearing Bones or Joints	
Femur—Upper metaphysis and hip joint	16	Humerus	5
Lower metaphysis	17	Shoulder joint with no bone involved	2
Tibia — Upper metaphysis	6	Scapula	1
Lower metaphysis	6	Clavicle	1
Entire shaft	2	Radius	1
Pelvis	2	Ulna	1
Spine	3	Elbow joint	1
Sacroiliac joint	3	—	—
Os calcis	3	Total	12
Fibula	2		
Ankle and tarsal joints 1 each.....	2		
Phalanx of foot.....	1		
Rib	1		
Hip joint without bone involvement	4		
Knee joint without bone involvement	2		
—	—		
Total	70		

Among these 82 lesions there were only 8 instances in 5 patients in which a joint was primarily invaded without bone involvement. These patients except 1 were under 2 years of age, and the causative organism was proved to be streptococcus in each of the 4 patients whose bacteriological study is recorded.

Bacteriology. In 34 of the 56 patients the bacterium responsible

for the disease is known. Every patient with hematogenous acute osteomyelitis must at some time have had a positive blood culture. In 26 of our patients in the acute stage of the disease a blood culture was taken and found to be positive in 19, an incidence of 73 per cent. Among these positive blood cultures there were 15 due to staphylococcus and 4 due to streptococcus, an incidence of almost 4 to 1 in favor of staphylococcus.

Cultures from the purulent exudate from the wounds revealed staphylococcus 21 times, streptococcus 3 times and a combination of staphylococcus and streptococcus 3 times.

Staphylococcus was the responsible organism in 79 per cent of the cases by blood culture and in 77 per cent by culture of the purulent exudate.

Each of these 2 bacteria has shown a selective action in this small series. Staphylococcus attacks the bones primarily, and we have no proved case of infection by this organism under the age of 2 years. Streptococcus tends primarily to invade the joints without bone involvement. It was the only known organism responsible in 3 out of 4 instances occurring under 2 years of age.

Treatment. Surgery on these patients presents numerous problems which must be confronted carefully and patiently. Thirty-nine, or approximately 70 per cent, of these 56 patients had a single focus of bone or joint infection, while 11 had 2 foci, 4 had 3 foci, 1 had 4 foci and 1 had 5 foci.

Forty-eight patients either in the acute or protracted stage of the disease required incision and drainage, and of these, 9 patients seen in the acute stage healed rapidly and have remained well with one operation only. The other 39 patients treated with drainage have had multiple operations, many performed in other hospitals, an average of approximately 3.5 per patient.

There were 8 patients who came to us with deformities incident to the ravages of the disease who were subjected to reconstructive operations. With but few exceptions all these patients had a prolonged hospital stay.

COMPLICATIONS

Ankylosis of Joints. Hip joint. There were 16 instances in which the upper extremity of the femur was invaded with the hip joint sec-

ondarily involved in each, and 4 instances of primary suppurative infection of the hip joint. The end result is known in 19 of these 20 patients and in no instance did the hip joint escape major damage.

Of the 16 patients with primary involvement of the upper femoral metaphysis and secondary suppurative arthritis of the hip, the end result is known in 15. In 11 patients, spontaneous fusion of the joint resulted, 2 were surgically fused and 2 others need surgical fusion. In each instance among those cases in which it was possible to recover bacteria from the blood stream or purulent exudate, staphylococcus was found. There is no instance in this series in which a staphylococcus infection of the hip joint failed to destroy that joint.

Of the 4 patients with primary suppurative arthritis of the hip joint, 3 of these known to be due to streptococcus, 1 patient died and each of the survivors required an operative stabilization of the joint.

Knee joint. The lower femoral metaphysis, invaded 17 times, showed 4 instances in which the knee joint was secondarily involved, resulting twice in bony ankylosis and twice in fibrous ankylosis with marked limitation of motion. Each of these patients had their initial drainage performed elsewhere. It is our belief that this complication should be prevented in most instances by proper drainage.

Ankle and tarsal joints were each invaded once with resulting spontaneous fusion.

Failure of the tibial shaft to regenerate. We have received from other clinics 2 patients who had massive involvement of the entire tibia and had had the tibial shafts resected. One patient regenerated his tibial shaft and the other failed to do so. This complication is said to occur in 19 per cent of cases in which the procedure is done.

Fracture. There were 2 patients who sustained a fracture of the upper femur at or near the epiphyseal line before coming under our care. They had not been adequately protected by brace or plaster-of-Paris during the acute stage of their disease.

Peroneal palsy. One patient whom we saw had a massive scarring of the posterior popliteal region and a complete peroneal nerve palsy. It must be assumed that his peroneal nerve was divided at one of his drainage operations.

Growth disturbance. Nine patients showed shortening of a leg: 3 under 1 inch, 4 between 1 and 2 inches and 2 from 2 to 3 inches.

One patient with a complete recovery of function following a

primary streptococcus arthritis of his knee had an increase in length of the involved leg of about $\frac{1}{4}$ inch.

END RESULTS

We fortunately know the end results in 54 of our 56 patients, a follow-up of over 96 per cent. We have classified our patients as *healed*, with or without disability; and *unhealed*, with or without disability. By disability we mean ankylosis of a joint, shortening of an extremity, limp, pain, etc.

Three patients have died, of our 34 seen during the acute stage. Two of these had acute staphylococcus sepsis and one, an infant, had streptococcus infection of the hip. Each died at about 1 week after onset. This gives a mortality of 8.8 per cent among our acute cases of hematogenous osteomyelitis and arthritis.

OF THE 51 KNOWN SURVIVORS, THE END RESULTS ARE AS FOLLOWS

	Without disability		With disability		Total Patients
	No. of patients	Per cent	No. of patients	Per cent	
Healed	26	51	12	23.6	38
Unhealed	5	9.9	8	15.4	13
Total Patients.....	31		20		51

The 13 patients who are rated as unhealed include 3 at present under treatment. It will be seen that though about 75 per cent of the patients are healed, only a little over half of the patients are healed without some disability.

CONCLUSIONS

1. Our experience in hematogenous acute osteomyelitis and arthritis simply offers corroboration on a small scale of many facts that have been previously noted. It is a disease of childhood and adolescence with males more frequently involved than females.

2. The bacteria responsible have been staphylococcus in nearly 80 per cent and streptococcus in most of the remainder. There seems to be a selective action on the part of these two bacteria, staphylococcus in the main affecting the bone primarily; and if a joint is invaded, it is by extension. Streptococcus tends to invade the joints primarily and predominates in infants.

3. The bones and joints of the lower extremity and other weight-bearing bones or joints are much more frequently invaded than those of the upper extremity. Of the long bones, the femur was most frequently invaded in this series.

4. Approximately 30 per cent of these patients had more than one focus of infection. A secondary invasion into the hip joint invariably has followed a focus in the upper femoral metaphysis. The knee joint in this series has been involved in 23.5 per cent of the cases involving the lower femoral metaphysis, and we feel that this may be unnecessary.

Growth disturbance ensued in about 17 per cent of those cases involving the lower extremities.

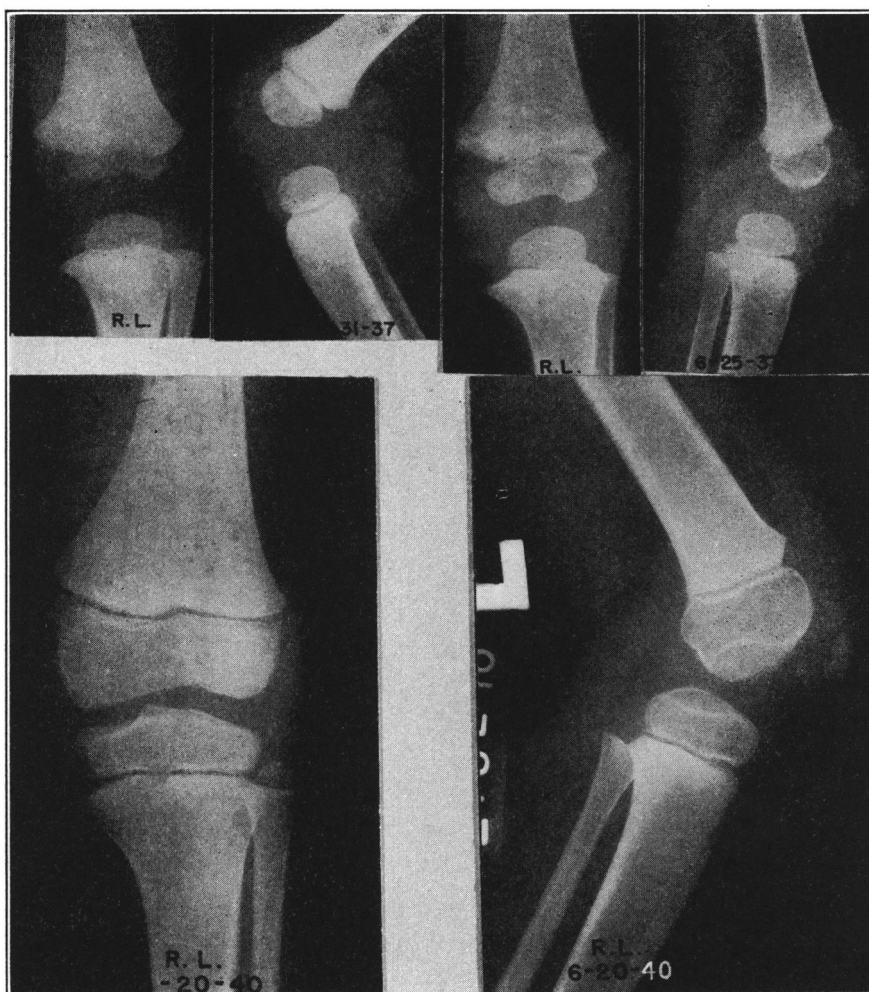
Fractures of diseased bones may be avoided by adequate protection with a plaster-of-Paris circular splint.

5. Approximately 75 per cent of our surviving patients have healed but almost a third of these have disability. Our mortality was 8.8 per cent of the 34 patients seen in the acute stage of their disease.

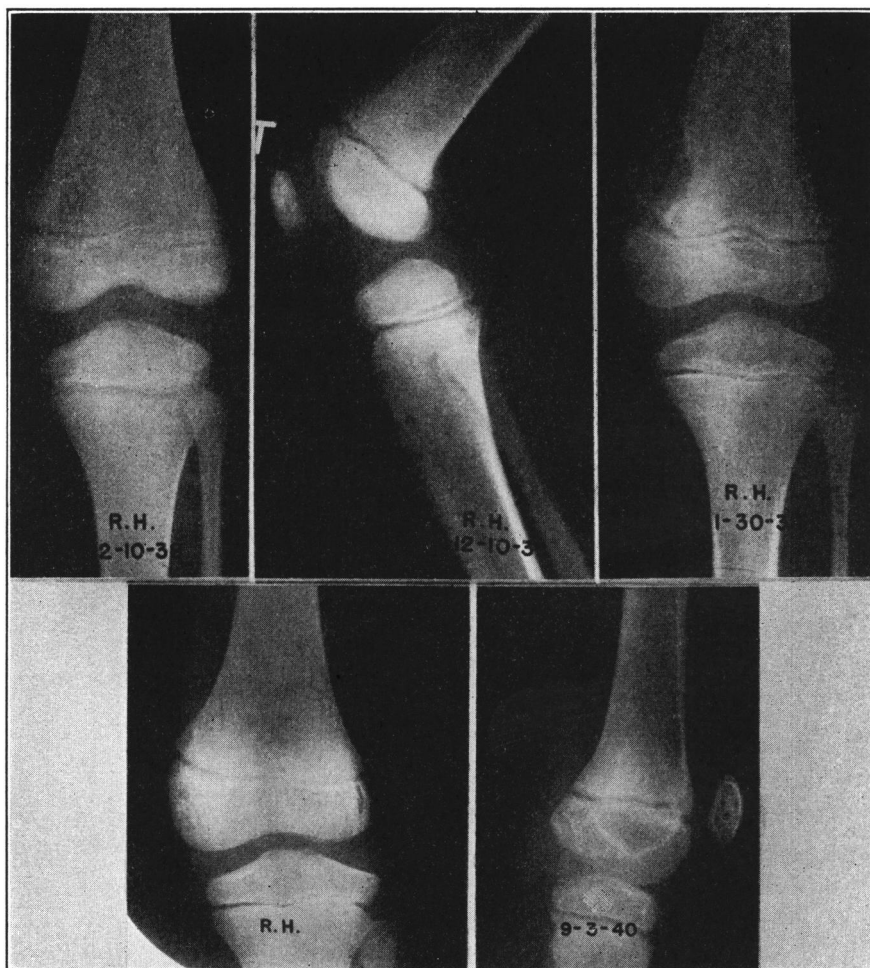
6. Our treatment of these patients seen in the acute stage of their disease is supportive: Infusions, transfusions, morphine and protection of the involved extremity. When we are satisfied that there is supuration, rapid drainage through small carefully placed incisions with minimal trauma followed by immobilization with circular plaster-of-Paris splints offers, we feel, the best treatment.

REFERENCES

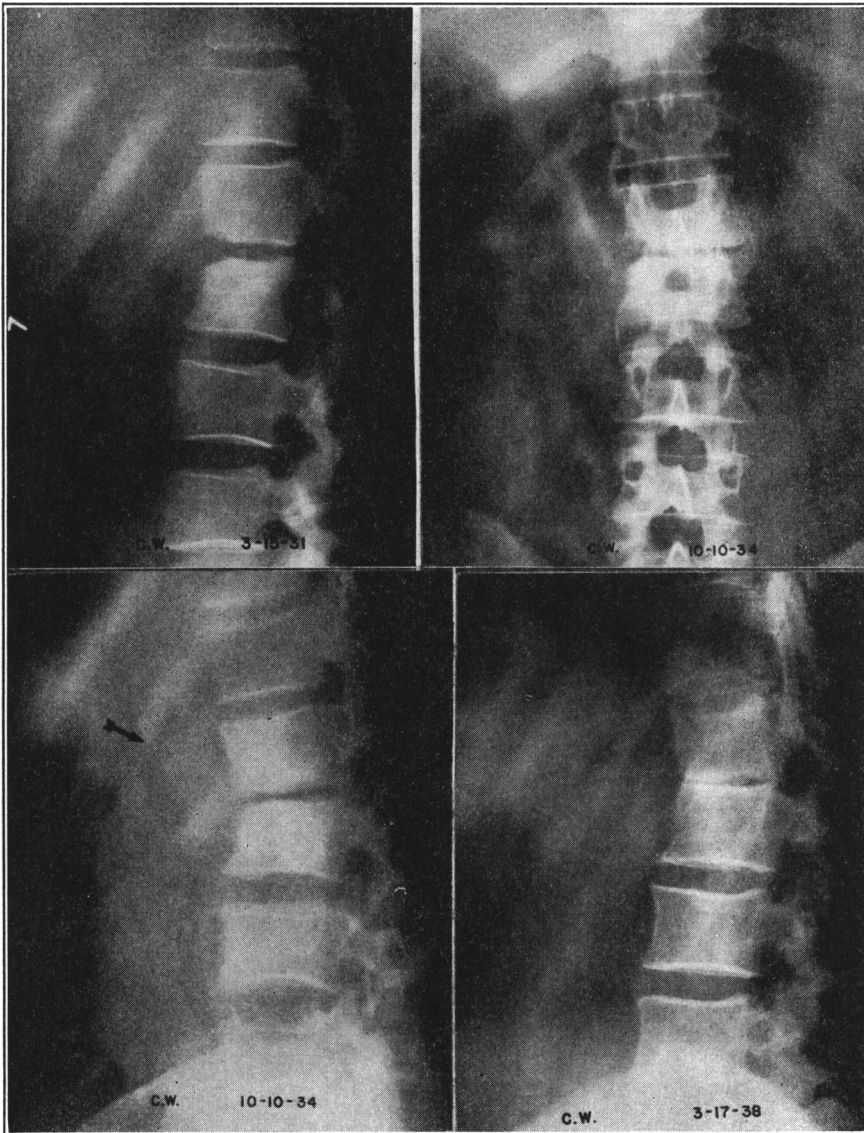
1. Wilensky, Abraham O.: *Osteomyelitis, its pathogenesis, symptomatology and treatment*. New York, Macmillan, 1934.
2. Beekman, F. and Sullivan, J. E. Blood-borne pyogenic infections of bones and joints, *Ann. Surg.*, 1940, 111:292.
3. Kennedy, Robert H. Osteomyelitis in compound fractures, *Am. J. Surg.*, 1937, 38:327.
4. Phemister, D. B. Pyogenic osteomyelitis, in *Nelson new loose-leaf surgery*, 1940, v. 3, chapt. 7.
5. Starr, C. L. Osteomyelitis, in *Practice of surgery* (Lewis), 1927, v. 2, chapt. 2.
6. Key, J. A. *Personal communication*.
7. Wilson, J. *Personal communication*.
8. Ryerson, E. W. *Personal communication*.



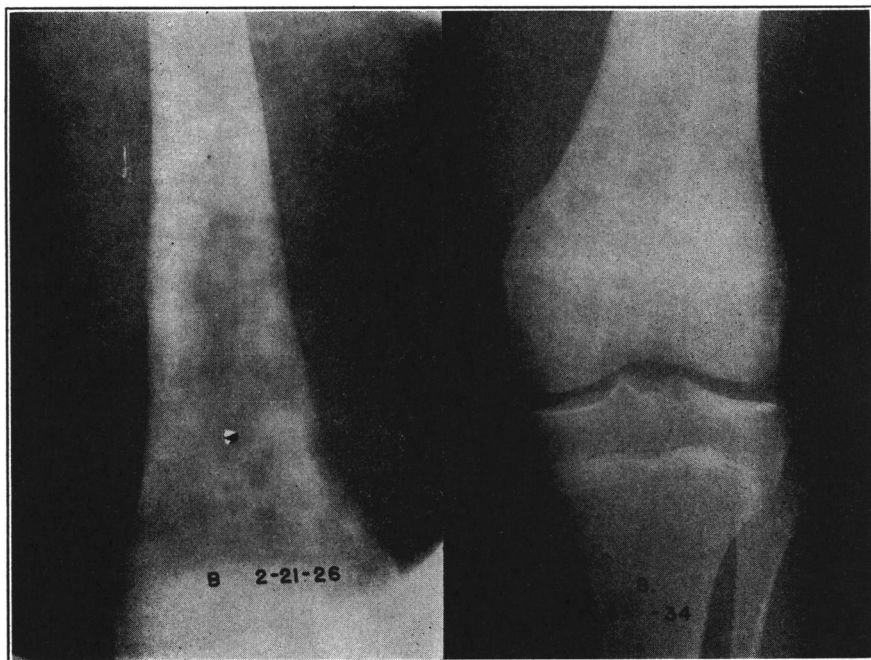
Case 1—R. L., St. Luke's No. A 10582, male, 19 months of age. He was admitted to St. Luke's Hospital March 31, 1937. About one month prior he had a cold and sore throat, and two weeks prior he had swelling of the left knee and fever. His temperature on admission was 104 degrees, white blood cells 80,000. Blood culture was negative. The patient showed effusion into the knee joint and very marked tenderness around the knee. It was not possible to be entirely certain whether this was suppurative arthritis or osteomyelitis involving the lower femoral metaphysis. On incision and drainage, drill holes were placed in the lower femur and upper tibia but no pus was found. However, the knee joint showed 20 cc. of pus which on culture was proved to be hemolytic streptococcus. The knee joint was drained by medial and lateral parapatellar incisions. A cast was applied and the patient was given sulfanilamide. His temperature fell to normal on the 16th day. The wound was entirely healed in 2½ months after operation. He was allowed to bear weight a week later. The roentgenogram of March 31, 1937 shows very definite distention of the capsule with no definite evidence of any involvement of the upper tibial or lower femoral metaphysis. That of June 25, 1937 still shows capsular distention and thickening. Those of June 20, 1940 show definite healing with a wide joint space and little or no disturbance of the femoral epiphysis. His latest follow-up, 3 years after operation, shows no limp, a full range of motion in his leg, and the left leg is ¼ inch longer than the normal leg. This is a very fortunate outcome in acute streptococcus arthritis of the knee joint in an infant.



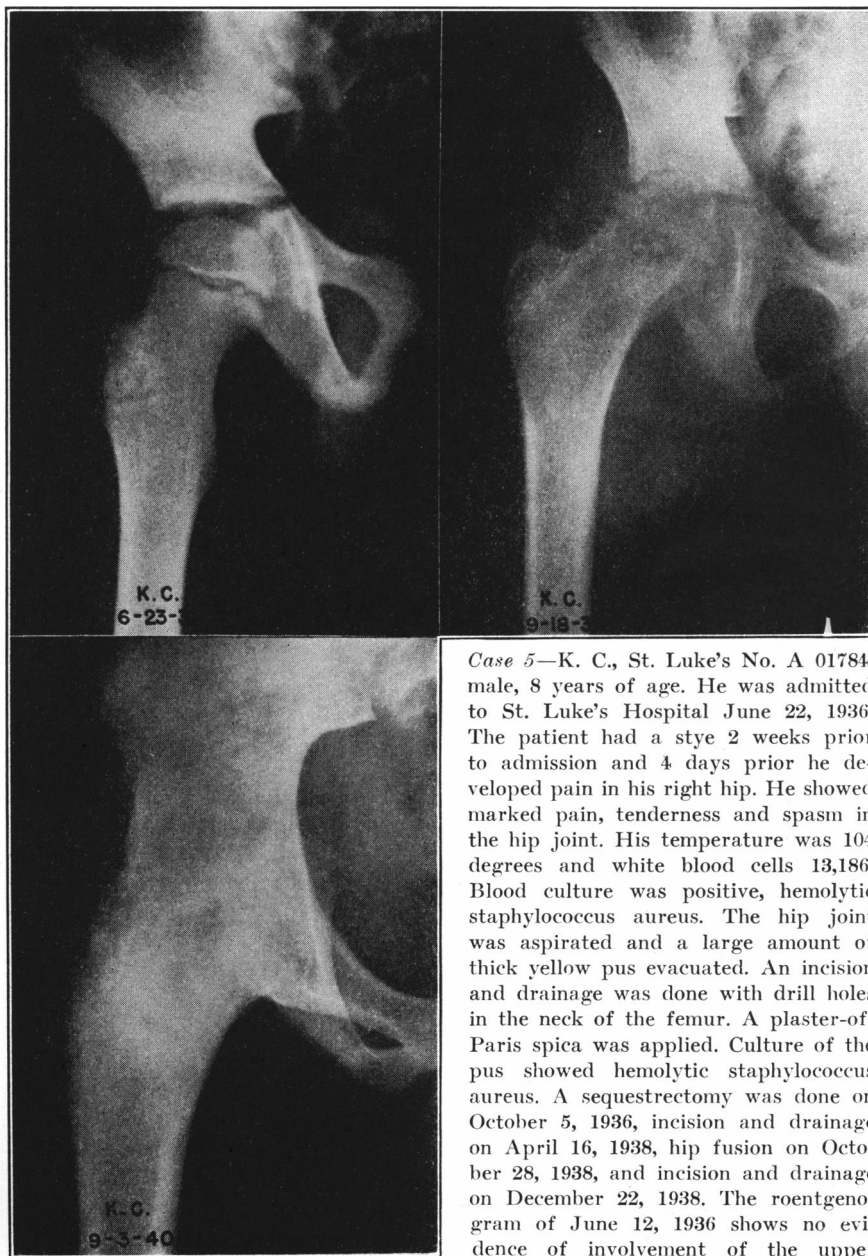
Case 2—R. H., St. Luke's No. A 6792, male, 8 years of age. He was admitted to St. Luke's Hospital December 9, 1938, 2 weeks after pain began in the left knee. He had no history of trauma or previous infection. Temperature was 104 degrees and white blood cells 14,400. Blood culture showed hemolytic staphylococcus. On December 19, 1938 an incision and drainage of the lower femoral metaphysis was performed through a trap cut in the bone. A plaster-of-Paris dressing was applied. He remained 54 days in St. Luke's Hospital. He was entirely healed in 4 months. The roentgenograms of December 10, 1938, antero-posterior and lateral, show involvement of the lower femoral metaphysis. The roentgenogram of January, 1939 shows the trap which has been removed from the femur, and those of September, 1940 show healing of the lesion. In September, 1940, nearly 2 years after onset, he has a full range of motion in his knee joint and hip joint, and his legs are of equal length. He has no additional focus. To date this has been a perfect result. This is a single lesion with a single operation, and he is healed without disability.



Case 3—C. W., St. Luke's No. 107-038, male, 56 years of age. Following a prostatectomy October 1, 1933, the patient ran a high temperature with localized infections, abscesses on his arm, phlebitis of the leg, etc. Blood culture was positive, *Streptococcus angiosus*. Within a month he began to complain of pain and stiffness in the small of the back, and by March, 1934 these "lumbago" pains had become very acute. The x-rays of the spine taken in March, 1934 showed a definite destructive lesion in the first and second lumbar vertebrae. His pain continued and by the latter part of November he had developed a large right psoas abscess which was incised and drained at St. Luke's Hospital. Following the operation a tiny sinus continued to discharge for 8 to 9 months and then healed. The lateral roentgenogram of the lumbar spine of March, 1934 shows a definite suppurative disease of the first and second lumbar vertebrae. The roentgenograms of October, 1934, antero-posterior and lateral, show progressive involvement of these two vertebrae with an enormous psoas abscess. The roentgenograms of March, 1938, lateral view, shows healing with some spontaneous fusion of the involved vertebrae.



Case 4—L. B., St. Luke's No. 111-080, male, 14 years of age. This patient gave a history of severe pain in the left knee with marked swelling and high fever following a long horseback ride. He was seen by two physicians who made a diagnosis of acute rheumatic fever. The patient had a systolic heart murmur. I saw the patient when his symptoms were subsiding and he was in his home without x-rays. I asked to have these taken but for some reason they were not taken. The patient within a month had a very nearly complete range of motion in his left knee. The first roentgenograms taken in February, 1926, 5 months later, showed very definitely that the patient had had an acute suppurative osteomyelitis of his femur. From 1925 through 1935 the patient has had about 10 small abscesses which have been incised and a number of small sequestra have been removed from the superficial tissues. This patient has played football and hockey all the way through college, and when last seen, 15 years after onset, he was healed. He had a full range of motion in his knee joint, and there has been no growth disturbance. The roentgenogram of February 21, 1926, shows rather massive involvement of the lower metaphysis of the left femur, and the roentgenogram of June, 1934 shows marked recalcification and healing with apparently one or two sequestra still in the femur. This patient is shown because of his original diagnosis of acute rheumatic fever, an error which, fortunately, was not disastrous.



Case 5—K. C., St. Luke's No. A 01784, male, 8 years of age. He was admitted to St. Luke's Hospital June 22, 1936. The patient had a styte 2 weeks prior to admission and 4 days prior he developed pain in his right hip. He showed marked pain, tenderness and spasm in the hip joint. His temperature was 104 degrees and white blood cells 13,186. Blood culture was positive, hemolytic staphylococcus aureus. The hip joint was aspirated and a large amount of thick yellow pus evacuated. An incision and drainage was done with drill holes in the neck of the femur. A plaster-of-Paris spica was applied. Culture of the pus showed hemolytic staphylococcus aureus. A sequestrectomy was done on October 5, 1936, incision and drainage on April 16, 1938, hip fusion on October 28, 1938, and incision and drainage on December 22, 1938. The roentgenogram of June 12, 1936 shows no evidence of involvement of the upper femoral metaphysis. The roentgenogram of September 18, 1936 shows very definite

involvement of the upper femoral metaphysis, a small sequestrum and marked thinning of the hip joint space. The final roentgenogram, September 3, 1940, shows the hip joint solidly fused in excellent position, no evidence of any sequestrum. There is no evidence of atrophy. This patient has been bearing weight quite steadily and is now healed.